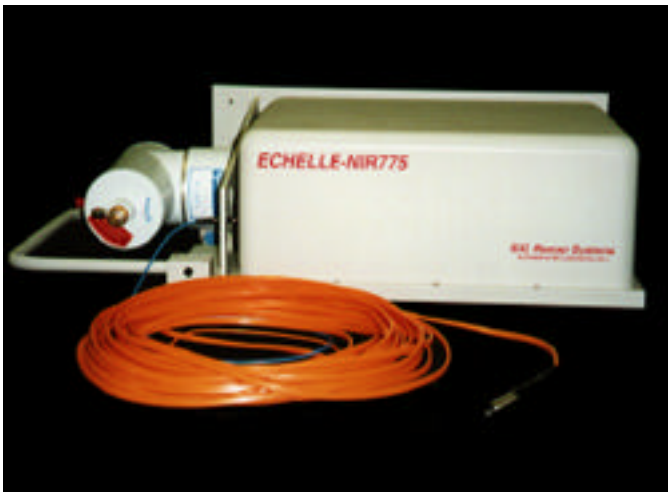
NASA Success Story

Raman Spectrometer



EIC Laboratories, Inc. of Norwood, Massachusetts is successfully commercializing the RS2000 Raman Spectrometer, based on a Small Business Innovation Research (SBIR) contract with NASA at Kennedy Space Center. The project called for the development and fabrication of a Real-Time Hypergolic Vapor Sensor based on Surface Enhanced Raman Spectroscopy (SERS). NASA needed an instrument to rapidly detect hypergolic propellant leaks, particularly monomethyhydrazine (MMH) and hydrazine (HZ), at the Space Shuttle launch pads, to ensure the safety of personnel and flight hardware during ground-based, prelaunch operations. EIC's subsidiary company, InPhotonics, offers the RS2000, the first Raman spectrometer to offer both high resolution and full spectral range capabilities in a system with no moving parts or throughput-limiting slits. Unique to the system is an echelle spectrograph that offers light dispersion in two dimensions to fully exploit the CCD detector area. The result is better than 1 cm-1 spectral resolution from 200 - 3500 cm-1 (Raman shift). No other system can provide this range and resolution without switching grating positions. The lens-based optics are matched to a fiber optic input, proving 1:1 imaging at the focal plane and negating the need for entrance slits. Commercial applications include chemical process monitoring, pharmaceutical analysis, forensics, environmental site characterization, and a general laboratory complement to infrared spectroscopy. For more information, see EIC Laboratories, Inc. Home Page at www.eiclabs.com

NASA Involvement The development of the SERS-based sensor had an immediate application for NASA-KSC's Space Shuttle ground-based operations. Phase I of the SBIR program demonstrated the feasibility of real-time detection and monitoring of HZ and MMH by a practical SERS-based instrument. Phase II saw the actual development and commercialization of the fiber optic, SERS-based instrument for gas monitoring applications. In addition to hypergolic detection, the system can also be configured for the detection of other gases, including nitrogen oxides. The system can

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NASA Success Story

Raman Spectrometer (Continued)

also be developed into a handheld detector for locating hypergolic fuels leaks or contamination during Space Shuttle landing operations.

Social/Economic Benefit Although numerous instruments have been developed for the detection of hypergolic vapors using electrochemical, colorimetric, infrared, chemiluminesence, and photoacoustic techniques, NASA found in general that these instruments are either incapable of meeting the detection limits, response time, accuracy, or stability requirements, or they are extremely expensive or difficult to configure and maintain as portable, fixed-point instruments or personal monitors. In contrast, SERS-based sensors have a number of potential advantages for detecting hypergolic vapors, including:

*Detection limits at the parts-per-billion level
*Real-time (~30 seconds) response
*Both qualitative and quantitative analysis capabilities
*Probe is intrinsically safe, since the signal is optical
*A high degree of specificity
*Simultaneous multi-component detection and analysis
*The visible laser source allows the transmission of the exciting radiation over long lengths of optic fibers required for an integrated, multi-probe monitoring system.

Industry Partner
EIC Laboratories, Inc.

NASA Partner
Kennedy Space Center

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